REMARKS

Claims 1, 2, 4-7, 9-14, 17, 23, 25, 29, 31, 33, 34, 36 and 37 are pending in this application.

The Office Action rejects claims 1, 2, 4, 6, 7, 12, 14, 23 and 25 under 35 U.S.C. §103(a) over Hsieh et al. (Hsieh), U.S. Patent No. 6,225,648, in view of Toshihiro et al. (Toshihiro), JP-1992-355541; and further in view of Lakhani, J. Appl. Phys., volume 56, page 1888; 15 September 1984. The rejection is respectfully traversed.

The combination of Hsieh, Toshihiro and Lakhani does not disclose, and would not have rendered obvious, a light emitting device having a contact layer that is designed to have an In concentration distribution in a thickness-wise direction thereof continuously reducing as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction, wherein a mean In concentration of the contact layer is adjusted within a range from 0.1 to 0.6 on the basis of atomic ratio of In to the total concentration of In and Ga, and wherein the contact layer is designed to have C_B/C_A of 0.8 or below, where C_A is In concentration at a boundary position between the contact layer and the ITO transparent electrode layer, and C_B is In concentration at a boundary position on the opposite side, as recited in independent claim 12 and similarly recited in independent claim 1

Having a mean In concentration of the contact layer of 0.1 or more and 0.6 or less on the basis of atomic ratio of In to the total concentration of In and Ga, and by having a C_B/C_A of 0.8 or below suppresses a quality deterioration such as a decrease of light emitting strength, a contact resistance decreasing effect of the contact layer being sufficiently maintained, and a lattice mis-matching of the contact layer and the light emitting layer section being suppressed (see, for example, page 7, line 15 to page 8, line 23 of the specification).

The Office Action acknowledges that Hsieh does not disclose an InGaAs layer formed by diffusing In to a GaAs layer from an ITO layer, but cites Toshihiro as allegedly overcoming the deficiencies of Hsieh.

Toshihiro discloses diffusing In to a thin GaAs layer by heat treatment (see Fig. 4 and paragraphs [0005] and [0013] of the machine generated translation). However, the heat treatment time of 5 minutes at 800 degrees C taught by Toshihiro is too long, and would not result in the inclined structure composed of In having a C_B/C_A of 0.8 or below. Thus, even though the ohmic contact in Toshihiro is improved, lattice matching of the InGaAs layer and the light emitting layer will deteriorate, and unconformity occurs so as to decrease the light emitting strength.

The Office Action applies Lakhani for the teaching that an ohmic contact layer to GaAs, formed by annealing an In-containing layer, results in an improved contact resistance and asserts that indium concentration and its distribution is a result-effective variable. However, Lakhani focuses on improving contact resistance, and improving contact resistance results in a decrease in light emitting strength. Therefore, following the teachings of Lakhani, the greater the amount of In diffused into the GaAs layer, the better the contact resistance. As such, based on the teachings of Lakhani, one would diffuse too much In into the GaAs layer and result in an unacceptable decrease in light emitting strength. Therefore, Lakhani does not disclose preventing a decrease of light emitting strength caused by lattice mis-matching of the contact layer and the light emitting layer section, by setting the In concentration of the contact layer at the boundary position with the ITO transparent electrode layer to 0.6 or less on the basis of atomic ratio of In to the total concentration of In and Ga.

Therefore, the combination of Hsieh, Toshihiro and Lakhani does not disclose, and would not have rendered obvious, a light emitting device having a contact layer that is designed to have an In concentration distribution in a thickness-wise direction thereof

continuously reducing as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction, wherein a mean In concentration of the contact layer is adjusted within a range from 0.1 to 0.6 on the basis of atomic ratio of In to the total concentration of In and Ga, and wherein the contact layer is designed to have C_B/C_A of 0.8 or below, where C_A is In concentration at a boundary position between the contact layer and the ITO transparent electrode layer, and C_B is In concentration at a boundary position on the opposite side, as recited in independent claim 12 and similarly recited in independent claim 1.

Further, with respect to dependent claims 6, 23 and 37, a contact layer that is composed of InGaAs has certain disadvantages with respect to conducting electricity to a light emitting layer section through an oxide transparent electrode layer. Specifically, when the band gap of the contact layer is small, there is a greater absorption of light emission. Thus, a large portion of the light emission is lost by the absorption before reaching the oxide transparent electrode layer. Even though the contact layer is aimed to extract light emission at a high efficiency through the oxide transparent electrode layer by covering the light extraction surface side of the light emitting layer section with the oxide transparent electrode layer having high transparency, utilizing the contact layer for its contact improvement deprives light emission and would defeat the purpose of the contact layer. Further, it would be meaningless to use the oxide transparent electrode layer with a contact layer that is used for contact improvement.

However, by forming an InGaAs contact layer to be a thin layer having thickness of 0.001 μm or more and 0.002 μm or less, despite the fact that the contact layer is formed with InGaAs having a higher light absorption rate than GaAs, the thinness of the contact layer eases influence of the light absorption greatly so as to improve the efficiency of light extraction through the oxide transparent electrode layer. The lower limit of thickness of the InGaAs contact layer is 0.001 μm because it is difficult to obtain adequate ohmic contact

since a contact layer thinner than 0.001 μm has a band structure different from a bulk crystal and has a different island growth configuration. Therefore, it would not have been obvious to one of ordinary skill in the art to modify the method of Hsieh with the teachings of Toshihiro and Lakhani to result in a contact layer within a range of 0.001 μm or more and 0.002 μm or less, as recited in dependent claims 6, 23 and 37.

Therefore, independent claims 1 and 12 and dependent claims 2, 4, 6, 7, 14, 23 and 25 are patentable over the combination of Hsieh, Toshihiro and Lakhani. Thus, it is respectfully requested that the rejection be withdrawn.

The Office Action rejects claims 9-11, 17, 29, 31, 33, 34 and 36 under 35 U.S.C. §103(a) over Hsieh in view of Toshihiro and Lakhani, and further in view of Saeki, U.S. Patent No. 6,483,127; and rejects claims 5, 13 and 37 under 35 U.S.C. §103(a) over Hsieh in view of Toshihiro and Lakhani, and further in view of Bass et al. (Bass), "Handbook of Optics - Volume 1, Fundamentals, Techniques, and Design", pages 12.1-12.39, 1995. The rejections are respectfully traversed.

Because the remaining claims incorporate the features of independent claims 1 and 12, respectively, and because Saeki and Bass fail to overcome the deficiencies of the other applied references, these claims also are patentable over the applied references for at least these reasons, as well as for the additional features that these claims recite. Thus, it is respectfully requested that the rejections be withdrawn.

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

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RRS:JTL/emd

Attachment:
Petition for Extension of Time

Date: February 5, 2009

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